Heidelberg mistletoes revisited: decadal changes in the distribution of Creeping Mistletoe *Muellerina eucalyptoides* on introduced trees in suburban Melbourne

Gregg Müller

School of Outdoor Education and Environment,
La Trobe University, Bendigo
Email: g.muller@latrobe.edu.au

Abstract
Introduced tree hosts of creeping mistletoe in Heidelberg, Victoria, were resurveyed after an interval of ten years. There was substantial turnover of hosts in the decade, and increasing disparity in the density of both infected trees and mistletoes between the elevated western block compared to the adjacent valley slopes to the east, with more than five times the density of infected trees and ten times more mistletoes in the west. Different potential host densities between the sites do not explain the differences in infection rates. (*The Victorian Naturalist* **124** (1), 2007, 27-32).

Introduction

Mistletoes have an intriguing biology – they are hemiparasites (they photosynthesise, but obtain their moisture and nutrient requirements from their host), that rely, at least in southern Victoria, on the Mistletoebird *Dicaeum hirundinaceum* to spread their seed. While mistletoe has often been seen as a pest, recent work indicates that mistletoes are important components of woodland and forest ecosystems (Watson 2001). They provide reliable nectar and fruit resources, often when little else is available, and shelter and nest sites for birds. Possums preferentially browse on mistletoe, and a number of species of butterfly rely on mistletoes as a host for their caterpillars.

Some mistletoes are host specific, but most species can parasitise a number of genera (Downey 1998). Creeping Mistletoe *Muellerina eucalyptoides* has successfully adopted a number of introduced deciduous tree genera as hosts in suburban Melbourne. The lack of leaves on the hosts in winter, and the closely spaced suburban street network means that surveying for mistletoes in the suburbs can be considerably more efficient than in native forests.

In 1997, *The Victorian Naturalist* published a special edition on mistletoes (Vol. 114 (3)). Included in the collection was a paper (Seebeck 1997) reporting on the distribution of Creeping Mistletoe *Muellerina eucalyptoides* growing on introduced host trees, primarily Cherry Plum *Prunus* sp., Plane Tree *Platanus* sp., Oak *Quercus* sp., Elm *Ulmus* sp. and Birch *Betula* sp. in a 300 hectare area of suburban Heidelberg, north of Melbourne. There have been few studies into changes in the spatial distribution of Australian mistletoes, so the inclusion of a detailed distribution map in that paper (Fig. 1) suggested a follow-up study to investigate changes in host distribution and infection patterns over the intervening decade.

Study area and methods

The study site spans the uneven rectangle bounded by Waterdale Road to the west and Rosanna Road to the east, and Southern Road and St James Road to the north and Banksia Street to the south (Fig. 1). The area is divided into two approximately equal blocks by Upper Heidelberg Road/Waiora Road, which runs north-south through the site, and which also forms a topographic boundary between the relatively flat elevated area to the west, and the slopes descending to the Yarra River to the east.

The area is a mix of older residential housing surrounding Burgundy and Bell Streets, and post Second World War suburban housing to the north, with scattered parks and some light industrial areas and shopping strips along the major roads. Little native vegetation grows within the area, apart from a small number of old eucalypts between Brown Street and St James Road.

Following the methodology of Seebeck (1997), each street was surveyed from a slowly moving vehicle in August 2005, when the lack of leaves on deciduous trees facilitated the detection of mistletoes. Roadside trees and private gardens were surveyed, but the two campuses of the Austin Hospital (Austin and Repatriation) were not. Mistletoes in evergreen trees were not surveyed. Each distinct clump of mistletoe was recorded, along with the host tree genus, and the position was logged using a Global Positioning System (GPS) unit. Since Creeping Mistletoe may have a creeping habit along the branches of its host, these clumps may not represent distinct individuals, but for the purposes of this paper they are considered as such. Where trees were heavily infested or observations were doubtful, closer inspection on foot and/or with binoculars was carried out. Host trees could generally be identified by morphology and bark. Doubtful identifications were rechecked when the plants were in leaf in April 2006.

Within the east block (area =1.428 km^2) 18.69 km of road was surveyed, representing a survey effort of 13.09 km per km^2. In the west (area =1.337 km^2), 21.61 km of road was surveyed, representing a survey effort of 16.16 km per km^2, a slightly higher figure than in the east due to the subdivision geometry.

In April 2006 a further survey was undertaken to establish the density of potential host trees in the area. Approximately 20 percent of the roads (4.148 km in the east, and 5.444 km of road in the west) in each block were surveyed from a slow-moving vehicle, and the genus and location of each potential host tree was recorded and logged with a GPS unit.

Results

Mistletoes

The location of infected trees is shown in Fig. 2. Infected street trees are plotted at the actual location (typically accurate to +/- 10 m using the GPS), but those occurring on private property are plotted at the nearest point on the street, and may be up to 30 metres from their actual location.

Mistletoe and infected tree densities are shown in Table 1. These figures may under - represent the true densities, since buildings and foliage, particularly in back and side yards, may have obscured mistletoes and host trees occurring on private property. Since the survey effort differed in the two blocks, the most accurate measure for comparison of mistletoe and host density is

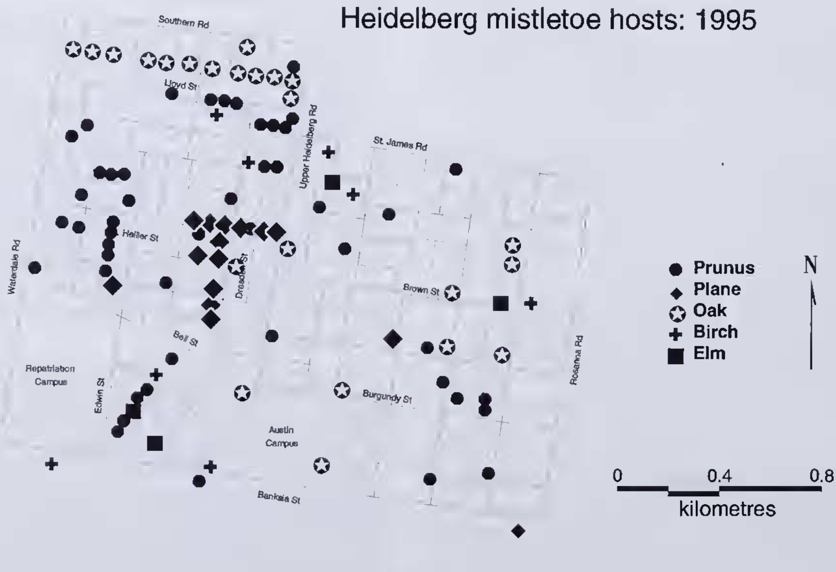

Fig. 1. Map showing distribution of mistletoe hosts in 1995.

Table 1. Density of infected hosts and mistletoes

Block	Number of hosts	Hosts per survey kilometre	Number of mistletoes	Mistletoes per survey kilometre
East	30	1.61	61	3.26
West	153	7.08	715	44.24

Table 2. Density of potential host trees

Block	Number of potential host trees	Survey distance (km)	Potential hosts per survey kilometre
East	130	4.148	31.34
West	141	5.444	25.90

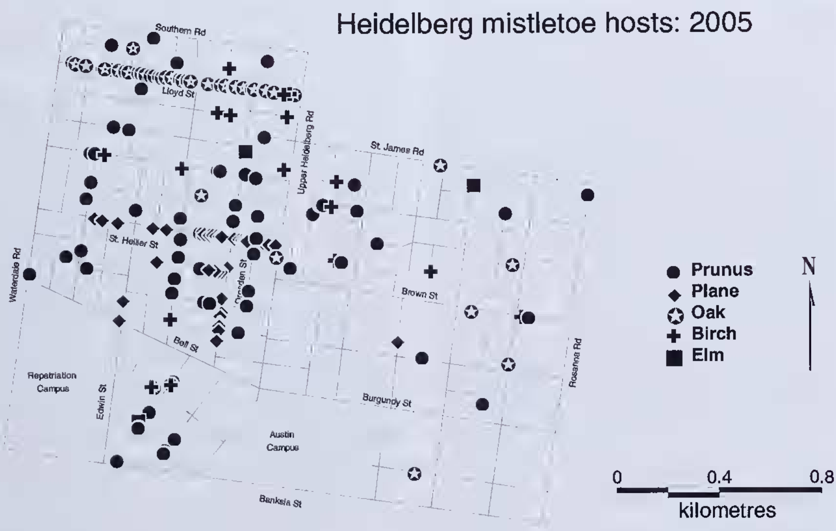

Fig. 2. Map showing distribution of mistletoe hosts in 2005.

mistletoes per survey kilometre and hosts per survey kilometre.

In the west block there were more than five times as many infected trees and more than ten times the density of mistletoes compared with the east black, both in absolute terms and relative to survey effort.

Potential host tree densities

The number of potential host trees per kilometre of survey in each block is shown in Table 2.

Incidental observation indicated that different host genera might have differing susceptibility to infection. If one area had more hosts of a particularly susceptible genus, then that might give rise to greater infected host densities in that area. A comparison of potential host density with actual host density by host tree genera between the east and west blocks indicates that differences in potential host densities between the blocks does not explain the marked difference in infected host density between the blocks (Fig. 3).

While relative densities of cherry plum are comparable across the blocks (black dots, left hand axis), actual infection rates (open squares, right hand axis) are considerably lower in the east block. Birch and oak densities in the east are more than twice those in the west, but infection rates are approximately three times lower. These results should be treated with caution for some genera. Plane trees, and to a lesser extent oaks, occur as discrete patches of street plantings, leading to a very 'lumpy' distribution across the study site, and the potential host survey, which only sampled a portion of each block, may have mis-represented the actual density of these genera in the blocks. Since cherry plum, birch and elm are more evenly dispersed across the area, they are considered unlikely to suffer from this limitation.

Changes in infection patterns, 1995 – 2005

A direct comparison of changes in the spatial distribution of mistletoes is not possible since Seebeck recorded infected host trees, rather than mistletoe plants. While Seebeck's text is not explicit, it appears that where multiple mistletoes occurred in an individual tree, only the host tree was recorded rather than the number of mistletoes within the host. The map included in that paper is also incomplete, since not all host trees bearing mistletoe referred to in the text appear on the map, for what appears to be reasons of cartographic simplicity. Where dense clusters of infected trees occurred, some cartographic licence seems to have been used, and the number of points shown on the map is less than the number of infected trees referred to in the text. Where the infected trees are more dispersed it is probably safe to assume that all of the infected trees were plotted on the map.

In spite of uncertainty in re-identifying some of the hosts in the older study, most individual hosts – particularly where only a single mature specimen of the host genus occurs in a location – can still be identified (Tables 3 and 4). If the Seebeck map is generally reliable, then overall mistletoe infection rates in the east block (where no dense clusters of infected trees occur) appear to be relatively stable, but with a considerable turnover in hosts.

No clear spatial pattern in persistence, abandonment or recruitment of mistletoe hosts in the east block was evident.

The picture is less clear in the west block. Since a high proportion of infections in the west block occur in tight clusters, estimates of persistence, recruitment and abandonment within these patches are unlikely to yield reliable data. The incomplete data included in the Seebeck map further complicates the issue. The data presented in Table 4 are only indicative of changes in the dispersed host areas outside of the clustered infection areas.

However, within these dense clusters changes can be inferred from Seebeck's text. Mistletoes in the row of oaks along

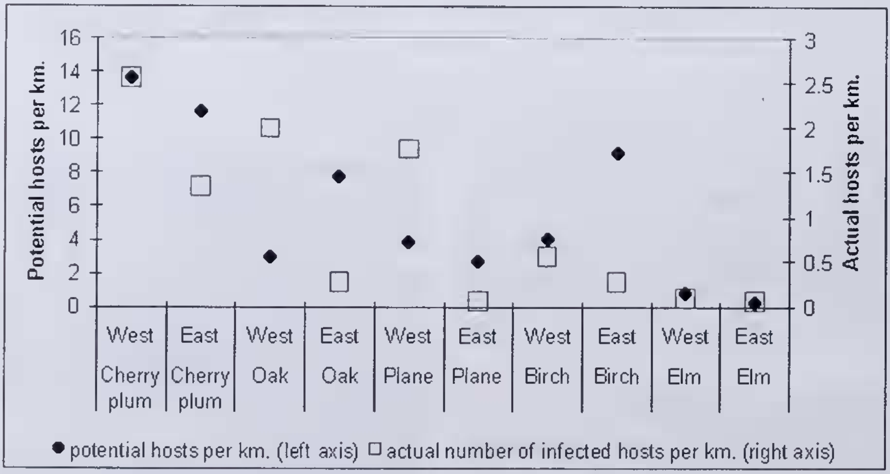

Fig. 3. Comparison of potential hosts and infections by genus, east and west block.

Table 3. Changes in host trees, East Block, 1995-2005.

Genus	Persistent host	Abandoned host	New host
Cherry plum	4	6	9
Elm	0	1	1
Oak	2	3	2
Birch	1	1	2
Plane	1	0	0
Other	0	0	2
Total	8	11	16

Table 4. Changes in dispersed host trees, West Block, 1995-2005.

Genus	Persistent host	Abandoned host	New host
Cherry plum	11	23	41
Elm	1	1	1
Oak	0	2	4
Birch	2	3	8
Plane	0	0	0
Other	0	0	3
Total	13	29	57

Lloyd St have expanded west from the original 15 hosts (out of 49) clustered at the east end of the street, to 39 infected trees (although Seebeck's map only shows 12 hosts).

Similarly, in the line of plane trees in Saint Hellier St, the mistletoe population has expanded from nine trees clustered toward the east end of the street, to 21 hosts, with the infection spreading west along the plantation. The group of mistletoes in the Dresden St plane tree plantation has expanded south and increased from the original six trees to nine (out of 17). However, in the nearby group of nine similarly aged planes in Edwin St infected trees have increased from only one infected tree to two.

Apart from a trend in host cycling similar to that noted in the east block, there appears to be a spread of infection from the high density patches at the east of the block toward the less densely infected areas to the west.

Discussion

While this research has shed some light on the distribution patterns and changes in mistletoe host density, it raises a considerable number of questions regarding the causes of the differences between the blocks.

The difference in density between the east and the west may be just a chance occurrence, but the fact that the pattern has persisted over ten years, while there has been considerable turnover in the mistletoe population, suggests this is not the case. The increase in infected trees in the west, while infection levels in the east have remained relatively stable, lends weight to that view.

Like any organism, the population of mistletoes is a function of the balance between recruitment and mortality. In the case of mistletoes, however, this is complicated by reliance on a specific vector (Mistletoebirds, *Diaceum hirundinaceum*) for spread, and host specificity for establishment.

From the data presented here, potential host densities are not the cause of differences between the blocks, since more potential hosts occur in the east where there is less mistletoe. Underlying geology and tree cover density (Müller, in prep.) appear not to be the causative factors either.

The differences may lie in the biology and behaviour of the vector or population control agents, or microclimatic differences arising from the topography that affect mistletoe establishment or vigour. Perhaps Mistletoebirds prefer the elevated area to the west of Upper Heidelberg Road to the valley slopes to the east. Department of Sustainability and Environment database records shed little light on the issue of Mistletoebird visitation, with only three records for the study area, all in the east block.

Differential distribution of possums, implicated as mistletoe control agents in other studies (Reid and Yan 2000) may be the cause. Again, records in the Department of Sustainability and Environment database are sparse. Only four records for Common Brushtail Possum *Trichosurus vulpecula* and three of Common Ringtail Possum *Pseudocheirus peregrinus* occur in the study area. Anecdotal reports from residents and the local municipality suggest that possums are fairly widespread although no quantitative data are available.

The apparent spread of mistletoes into previously unoccupied hosts in the west block indicates an increase in recruitment occurring in the west block but not in the east. This may be due to chance, to changed circumstances occurring over the past decade in the west but not the east, or alternatively, because long-term equilibrium in the mistletoe population has not yet occurred in the west block.

Anthropogenic factors may be another causative factor. Differences in gardening habits and choices, behaviour, and pet choices – which may influence both Mistletoebirds and possums – may all have some influence on mistletoe distribution.

Mistletoes are considered to be keystone resources in forests and woodlands (Watson 2001) and the same may hold for urban ecosystems. If this is true, then mistletoes on introduced trees may be a critical element in establishing and maintaining diverse ecosystems in our cities and towns, particularly since the densities reported here are considerably higher than I have observed for Box Mistletoe *Amyema miquelii* in forests in central Victoria (unpubl. data).

The high visibility of mistletoes in deciduous trees during winter makes mistletoe study in urban areas considerably easier than in native forest settings. The relatively good historical records that exist for urban areas, and the ease of access and large number of potential observers in these locations suggest that the suburbs may be a prime location for untangling the complexities of mistletoe ecology.

References

Downey PO (1998). An inventory of host species of each aerial mistletoe species (Loranthaceae & Viscaceae) in Australia. *Cunninghamia*, **5**, 685-720.

Reid N and Yan Z (2000) Mistletoes and other phanerogams parasitic on eucalypts. In *Diseases and Pathogens of Eucalypts* pp 353–384 Eds Keane, PJ, Kile, GA, Podger, FD and Brown, BN (CSIRO Publishing: Melbourne).

Seebeck J (1997) Creeping mistletoe *Muellerina eucalyptoides* in suburban Melbourne. *The Victorian Naturalist* **114**, 130-134.

Watson, DM (2001) Mistletoe - a keystone resource in forests and woodlands worldwide. *Annual Review of Ecology and Systematics* **32**, 219-249.

Received 5 June 2006; accepted 16 November 2006

A Valentine's Day poem

Goodenia ovata is yellow in flower
As bright as my love, for you every hour
While the Common Hovea is purple in hue
(Well it's actually mauve, between me and you)
The *Caladenia rosella* has petals of red
'Tis the colour of passion, it's often been said
But the best plant of all for the job of type-casting
Is the *Bracteantha bracteate* – the Golden Everlasting
Its name says it all, in colour and style
Like my love, it is pure and goes on all the while

written by one of the Editors
for his wife